

# BASF North Works Phase II Sediment Investigation:

## Preliminary Data Review & Proposed Next Steps

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Chicago, IL  
March 19, 2009

# Presentation Outline

- Phase II Sediment Investigation Overview
- Core Collection & Processing
- Data Review & Analysis
  - Reference Areas
  - Along-Site Areas
- Preliminary Interpretations
- Next Steps & Schedule



## Phase II Sediment Investigation Overview

- Objective: Evaluate sediment quality adjacent to North Works relative to upstream sediments
  - Collected & analyzed 26 upstream cores: 6 upstream of Mud Island, 5 near Mud Island, 2 in Ecorse River, 3 downstream of Ecorse River, 4 near Libra Marina, and 6 near Grassy Island
  - Collected & analyzed 30 cores from established along-site transects: 1 from Northern Area (T-01 to T-03), 29 from Southern Area (T-19 to T-29)
  - Submitted samples from 3 upstream & 3 along-site cores for geochronological analysis

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# CORE COLLECTION & PROCESSING

## Core Collection

- Vibracore sampling Oct. 14<sup>th</sup>-24<sup>th</sup> (2 cores in Libra Marina by hand Nov. 24<sup>th</sup>)
- Some upstream locations adjusted to increase sediment recovery; some abandoned and new locations substituted
- Upstream areas probed to locate potential depositional areas for core sampling

Analytical Cores	Upstream <sup>1</sup>	Along-Site	Grassy Island
Proposed	20	34	6
Collected	28 <sup>2</sup>	34	6
Submitted for Analysis	20	30 <sup>3</sup>	6

**Notes:**

- 1) Upstream core count includes cores collected in Ecorse River and Libra Marina.
- 2) Collected upstream core count includes “A” and other locations with little sediment recovery that were subsequently relocated or replaced.
- 3) Locations T01-75; T02-25; T02-50; and T03-25 had very little sediment thickness and no samples were submitted for analysis. Probable depth previously observed was found to be composed of soft Native Clay versus sediments in these areas (Along-Site North).

# Core Processing

- Cores temporarily stored and processed at Riverview facility
- Lab samples submitted per analyte list in the Work Plan



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# DATA REVIEW & ANALYSIS



# Types of Data Collected During Field and Processing Activities

- Water Depth
- Probe Depth
- Recovery Depth
- Photographs
- Sediment Descriptions/Stratigraphy
- NAPL Observations
- Sediment Slurry pH
- Samples for Laboratory Analysis



**U19 – Upstream of Mud Island  
NAPL Present at 2.9-3.2 feet**



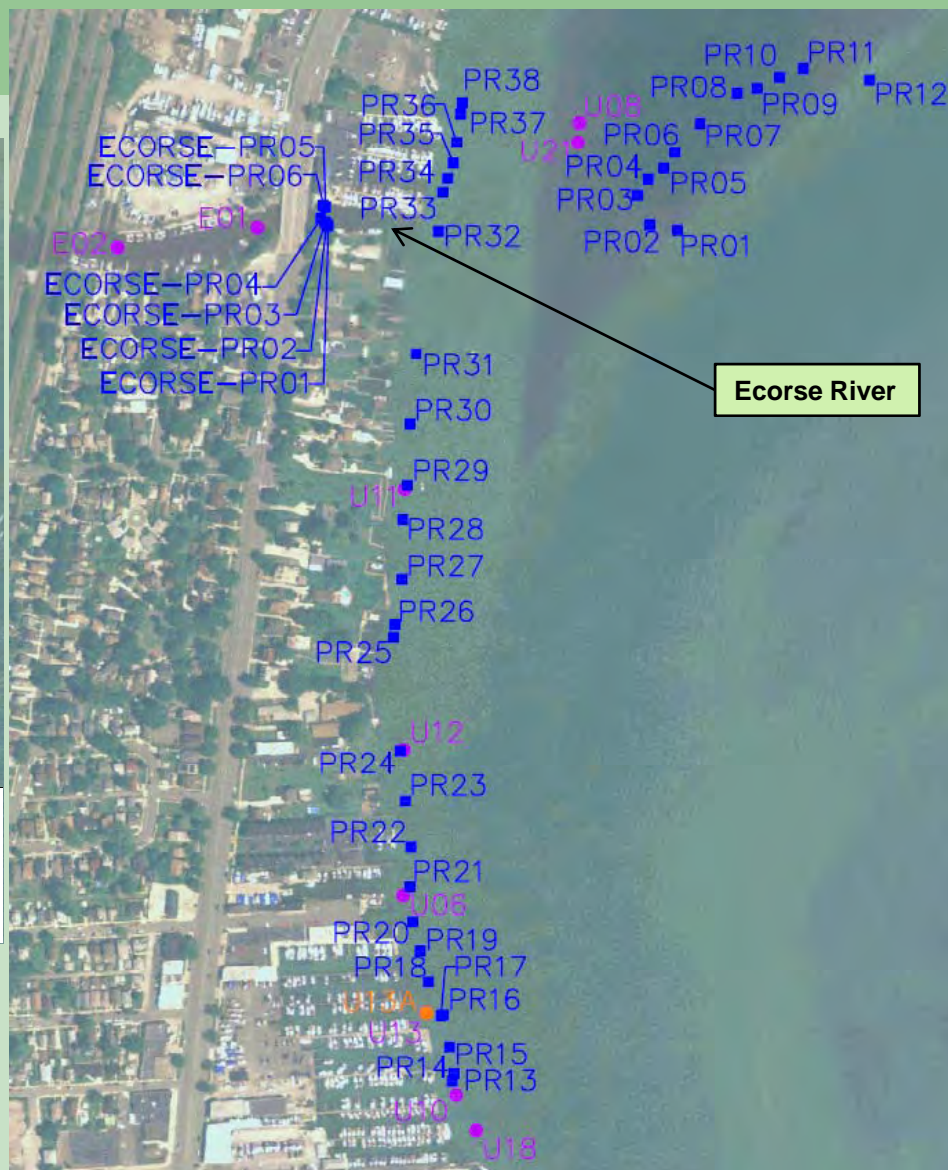
**T27-50 (6-7.9 feet)  
Along-Site South Area**



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# Upstream Probing & Core Locations



# Upstream Core Field Data Summary

- Upstream pH Range: 6.9 to 10.5 \*
  - Max upstream pH of 10.5 at U14 – near entrance of Libra Marina
- Locations of greatest sediment deposition:
  - Upstream of Mud Island – up to 8 ft
  - Downstream of Grassy Island – up to 5 ft
- Sediment generally dark-brown or gray-brown silt, or fine sand over gray-brown silty clay
- Locations with very little to no sediment recovery:
  - U03, U08A, U09A (Near Mud Island)
  - U12, U06, U13A, U18 (Downstream of Ecorse River)
- NAPL observed in cores U04, U19, & U20 (upstream of Mud Island)

\* Note: All pH values in Standard Units (S.U.) and rounded to one decimal place.

# Libra Marina Core Field Data Summary

- 1.5 to 4.1 ft of sediment recovery
- U14 pH range 9.5 to 10.5
- U15 pH range 8.1 to 9.5
- U16 & U17 located in Libra Marina
  - pH range from 7.2 to 9.0



# Labadie Concrete (c.a. 1947-1973)

## Libra Marina Area – Historical Aerial Photo circa 1937 (courtesy of MDEQ)



Site of Former Labadie Concrete  
Products Company (ca. 1947 – 1973)  
(Source: EDR City Directory Abstract)

Libra Marina

Sample Locations Approximate  
Max pH at Location

- 7-8
- 8-9
- 9-10
- 10-11



# Libra Marina Core Examples

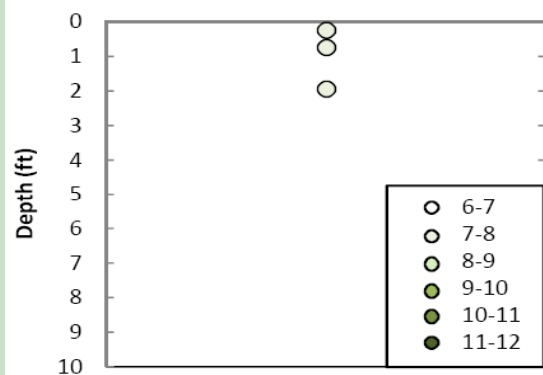
**U17 – In Libra Marina**



**U17**

Depth (feet)	Sediment Description
0-1.3	Dark gray brown SILT, fine sand, trace coarse sand, trace organics, odor
1.3-2	Light to dark brown fine SAND, silt, trace coarse sand, trace organics
2-2.9	Dark brown to gray fine SAND, silt, trace gravel, trace organics

**Upstream pH Data**



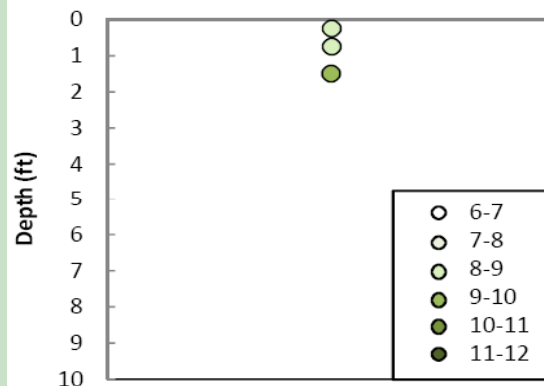
**U16 – In Libra Marina**



**U16**

Depth (feet)	Sediment Description
0-1.1	Dark brown SILT, trace organics, trace fine sand, slight odor
1.1-2	Brown fine SAND, some silt, trace organics, trace gravel
2-2.6	Gray to brown CLAY, trace fine sand, trace coarse sand, moderately soft, trace organics

**Upstream pH Data**



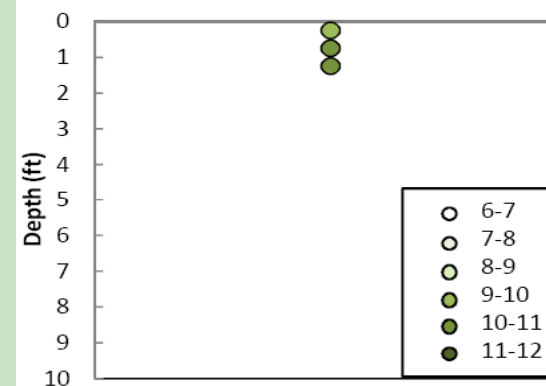
**U14 – Near Mouth of Libra Marina**



**U14**

Depth (feet)	Sediment Description
0-1.5	Dark gray inter-bedded fine SAND and SILT, trace medium to coarse sand, trace fine to medium gravel, slight odor

**Upstream pH Data**

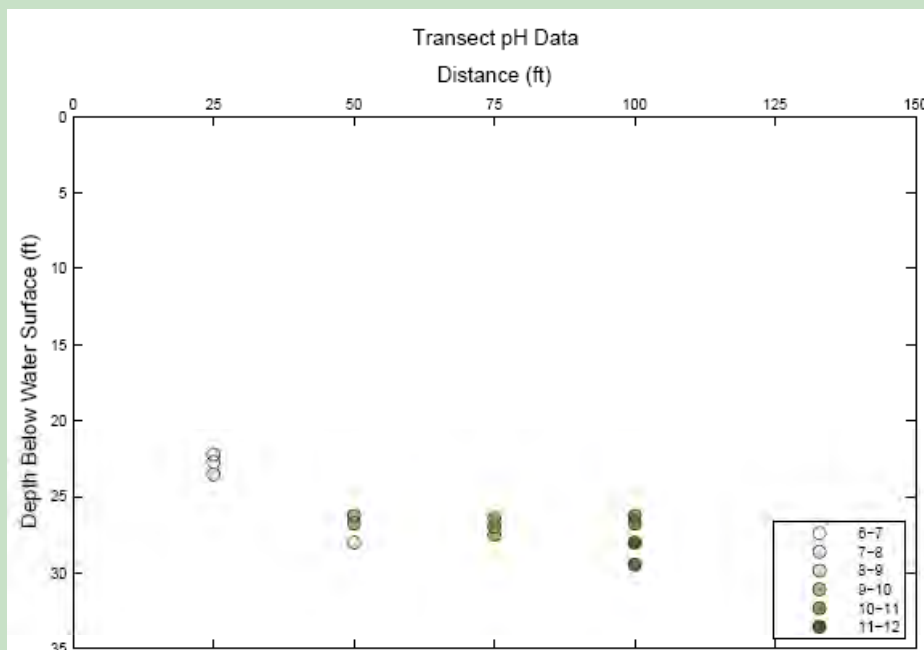


# Along-Site Core Field Data Summary

- 11 Transects targeted
  - 3 near North area
  - 8 along South area
- 34 cores collected, 30 analyzed
- North Area: Transects 01, 02, & 03
  - 4 out of 5 cores collected had insufficient sediment thickness
    - Native Clay observed to be soft and probe-able
- South Area: Transect 19 through 29
  - Light colorations, crust fragments
  - Field testing indicates elevated pH

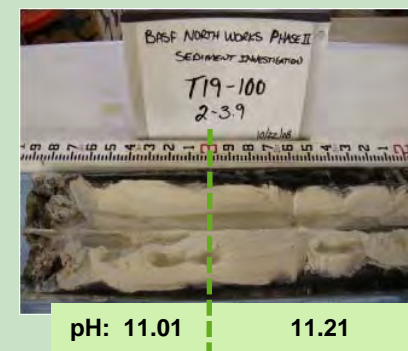
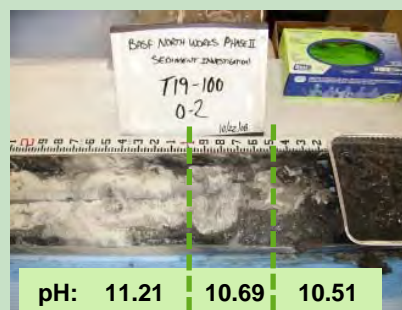
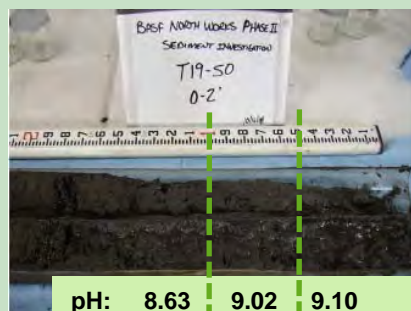


# Transect 19



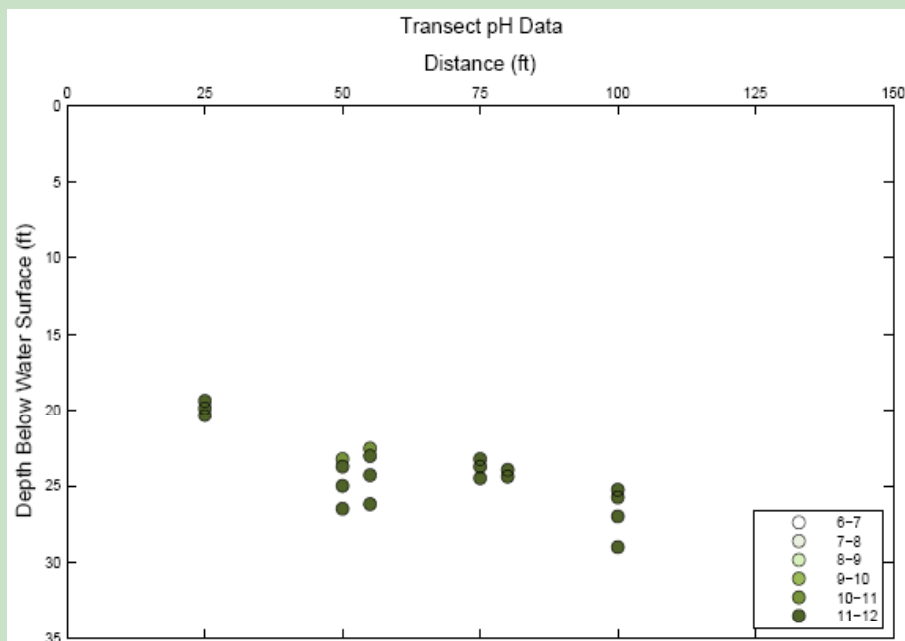
## T19-100

Depth (feet)	Sediment Description
0-0.4	Dark gray brown very loose SILT, little fine sand, trace fine gravel, trace NAPL blebs, slight odor
0.4-3.7	Light gray grading to white SILT, trace fine sand, odor
3.7-3.9	Light gray fine to coarse SAND, trace fine to medium gravel





# Transect 23

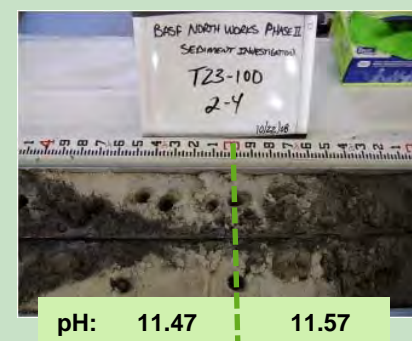
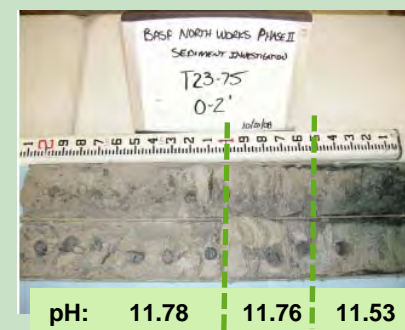
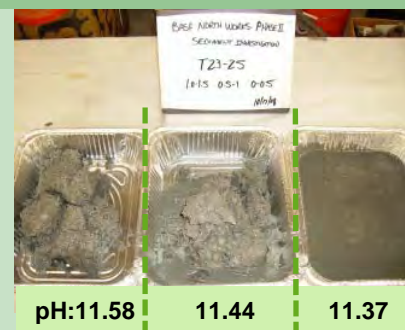


T23-50

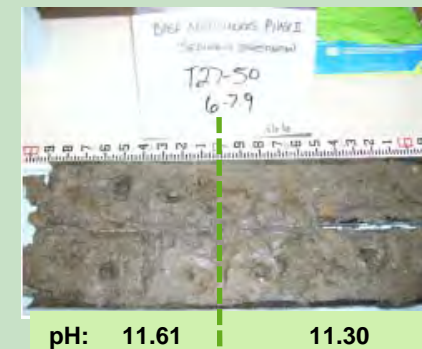
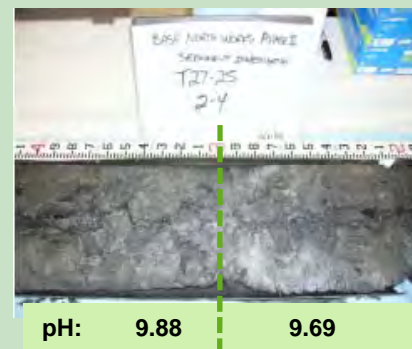
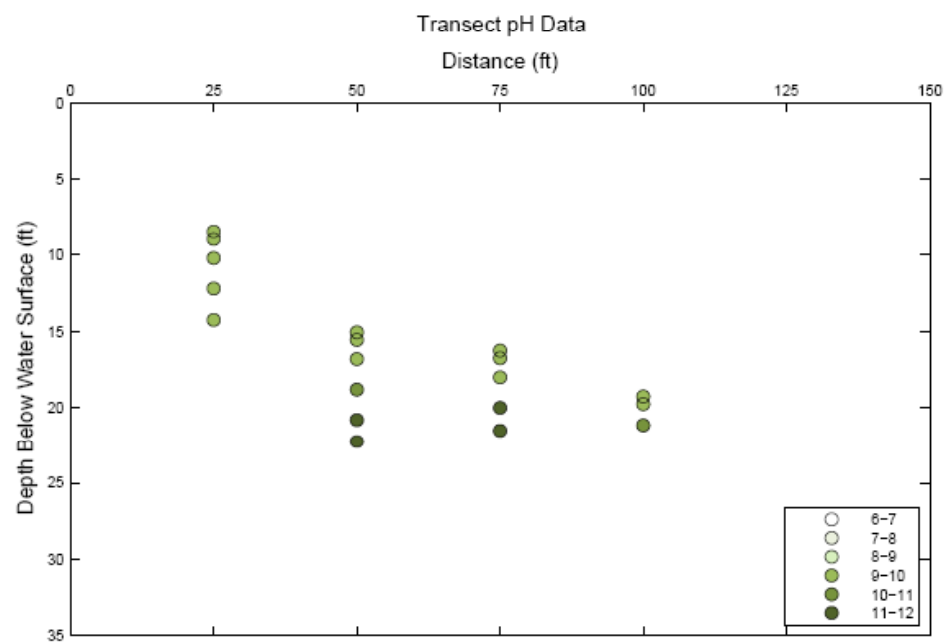
Depth (feet)	Sediment Description
0-0.5	Dark gray SILT, trace fine sand, odor
0.5-4	Dark gray grading to light gray SILT, trace fine sand, odor

T23-75

Depth (feet)	Sediment Description
0-2	Blue-ish gray grading to light gray SILT, trace fine sand, odor



# Transect 27



T27-75	
Depth (feet)	Sediment Description
0-3	Gray brown very loose SILT, trace fine sand, trace slag, odor, trace NAPL blebs
3-3.8	Dark gray SILT, trace fine sand, odor
3.8-5.4	Gray brown fine SAND, little light gray silt, odor
5.4-6	Dark gray brown SILT, trace fine sand, odor

T27-100	
Depth (feet)	Sediment Description
0-1.6	Dark gray brown SILT, trace fine sand, trace organics (vegetation), odor
1.6-2.4	Dark gray brown fine SAND, trace silt, odor
2.4-3.3	Light gray brown SILT, trace fine sand, odor



## pH Spatial Trends

- Upstream pH > 9 detected near Libra Marina area (unknown extent)
- Along-site pH > 9 limited to T19 to T29
- General increase in pH with depth
  - Max pH deeper than 1 ft in 76% of samples from T19 to T29
- General increase in pH values at stations further from shore
  - Max field pH of 11.9 recorded at location T23-100 (0.5-1.0 ft)
- Layer of light-colored material present at 10 core locations from T19 to T29 coinciding with elevated pH
  - Observed in 6 of 7 sample locations at 100 ft from shore

## Considerations with Respect to pH

- No human exposure along-Site due to water depths, access restrictions
- Minimal surface water pH impacts expected due to River flows
- Ecosystem exposure primarily limited to benthos due to water depth<sup>1</sup>
- Benthic toxicity throughout Detroit River documented by others<sup>2</sup>
  - Upstream stressors exist, pH an additional issue along-Site
- Exposure undetermined, unknown representativeness of data at depth
  - Natural sediments have deposited over the historical material
  - Mineral ( $\text{CaCO}_3$ ) precipitate/crust should limit interface pH effects
    - Geochemical analysis indicates this should occur, site observations suggest this is present
- Representativeness of field pH measurements on sediment-water interface, and bio-available zone conditions need to be determined

**Notes:**

1) Average water depth in study area was 19.8 feet.

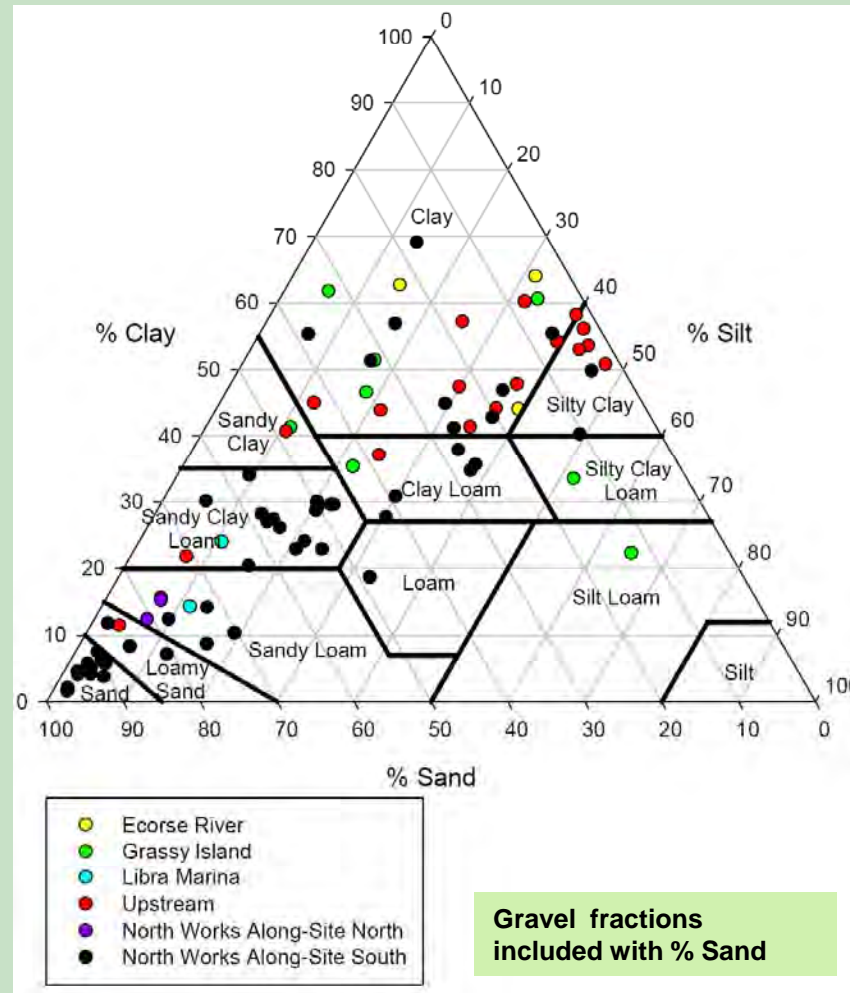
2) E.g., DREAMS 2000, Journal of Great Lakes Research 1996, Beak Consultants 1993.

# Upstream v.s. Along-Site Data Comparisons

- Upstream reference area data compared to along-site samples to assess if discernable differences are present
  - Field pH readings
  - Laboratory analytical results
  - Considered effect of variable percentage of fine sediments due to river velocity variations (different depositional environments)
    - Aluminum, grain-size, and organic carbon normalization
- Graphical comparisons
  - Plots of summary statistics, concentration vs. position in river
- Calculation of Background Screening Levels (BSLs)
- Various statistical tests performed per the Work Plan



# Sediment Textural Analysis



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# PRELIMINARY INTERPRETATIONS



# Preliminary Upstream vs. Along-Site Data Comparison Results

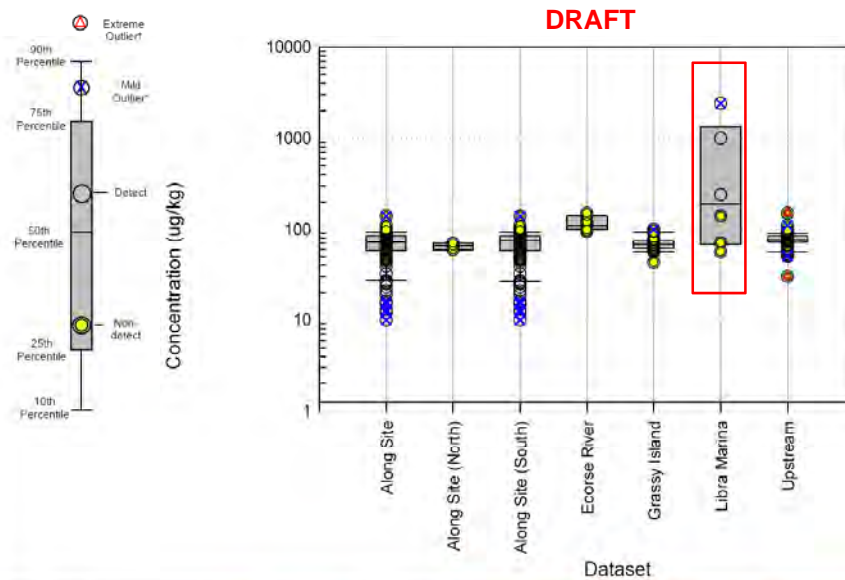
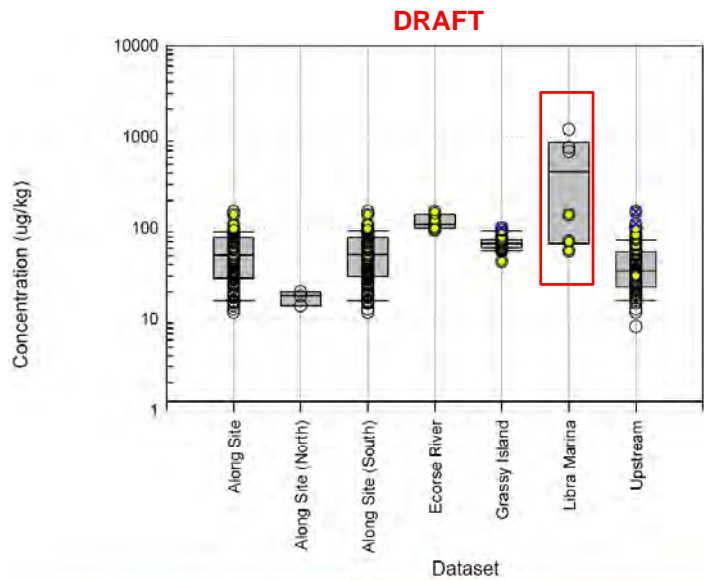
- Data support hypothesis that along-site sediments are in a continuum of degraded sediment quality extending from upstream areas
  - Concentrations of many constituents (including mercury) are consistent with upstream sediments
- Discernable differences are apparent for some analytes, including pH
- Upstream data indicate source issues for a number of constituents
  - Benzene and 1,2-dichlorobenzene in Libra Marina
  - Metals upstream and in Ecorse River (e.g. vanadium and zinc)
  - PAHs and visual NAPL in upstream samples (U04, U19, U20)
    - Finer NAPL “blebs” in Along-Site cores also occur at upstream locations
  - Max Total PCBs<sup>1</sup> observed upstream: 46.4 mg/kg at U04 (0.5 to 1.0 ft)
  - pH near former Labadie Concrete (near current Libra Marina)

1) Sum of Arochlors 1248, 1254 and 1260

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# Example Boxplots Benzene, Chlorobenzene



**Sediment Box and Whisker Plot  
BENZENE**  
IRAG Corporation, Wyandotte, MI

**Figure  
D-62**



**Sediment Box and Whisker Plot  
CHLOROBENZENE**  
IRAG Corporation, Wyandotte, MI

**Figure  
D-63**

Dataset	Units	Sample Size			ND Range		Detects					Percentiles (All Data)			Dataset	Units	Sample Size			ND Range		Detects					Percentiles (All Data)			
		NDs	Detects	Total	Min	Max	Min	Max	Mean	Median	SD	25th	50th	75th			NDs	Detects	Total	Min	Max	Min	Max	Mean	Median	SD	25th	50th	75th	
Along Site	ug/kg	60	64	124	45.0	140	12.0	150	33.0	29.0	22.2	29.0	50.5	78.0	Along Site	ug/kg	100	19	119	45.0	140	10.0	65.0	30.5	25.0	17.5	58.0	72.0	84.0	
Along Site (North)	ug/kg	0	3	3	NA	NA	14.0	20.0	17.3	18.0	3.1	15.0	18.0	19.5	Along Site (North)	ug/kg	3	0	3	59.0	70.0	ND	ND	ND	ND	ND	61.0	65.0	68.8	
Along Site (South)	ug/kg	60	61	121	45.0	140	12.0	150	33.8	30.0	22.5	30.0	51.0	78.0	Along Site (South)	ug/kg	97	19	116	45.0	140	10.0	65.0	30.5	25.0	17.5	58.0	74.0	84.5	
Ecorse River	ug/kg	7	0	7	94.0	150	ND	ND	ND	ND	ND	100.0	110	135	Ecorse River	ug/kg	7	0	7	94.0	150	ND	ND	ND	ND	ND	100.0	110	135	
Grassy Island	ug/kg	20	0	20	43.0	100.0	ND	ND	ND	ND	ND	62.0	67.5	74.0	Grassy Island	ug/kg	20	0	20	43.0	100.0	ND	ND	ND	ND	ND	62.0	67.5	74.0	
Libra Manna	ug/kg	3	3	6	56.0	140	690	1,200	883	760	276	71.0	415	760	Libra Manna	ug/kg	3	3	6	56.0	140	240	2,400	1,210	1,000	1,100	71.0	190	1,000	
Upstream	ug/kg	18	51	69	30.0	150	6.3	69.5	31.0	29.5	14.5	23.0	34.0	55.3	Upstream	ug/kg	69	0	69	30.0	150	ND	ND	ND	ND	ND	ND	72.0	76.0	84.3

Notes:

† Result value is < 25th percentile - 3\*IQR or > 75th percentile + 3\*IQR

\* Result value is < 25th percentile - 1.5\*IQR or > 75th percentile + 1.5\*IQR

NA = value not applicable due to frequency of detection

ND = nondetect

IQR = interquartile range equals the 3rd quartile (75th percentile) - 1st quartile (25th percentile)

SD = standard deviation

Reporting limit is used for nondetects unless otherwise noted.

Values less than 10 are reported to 2 significant figures. Values greater than 10 are reported to 3 significant figures.

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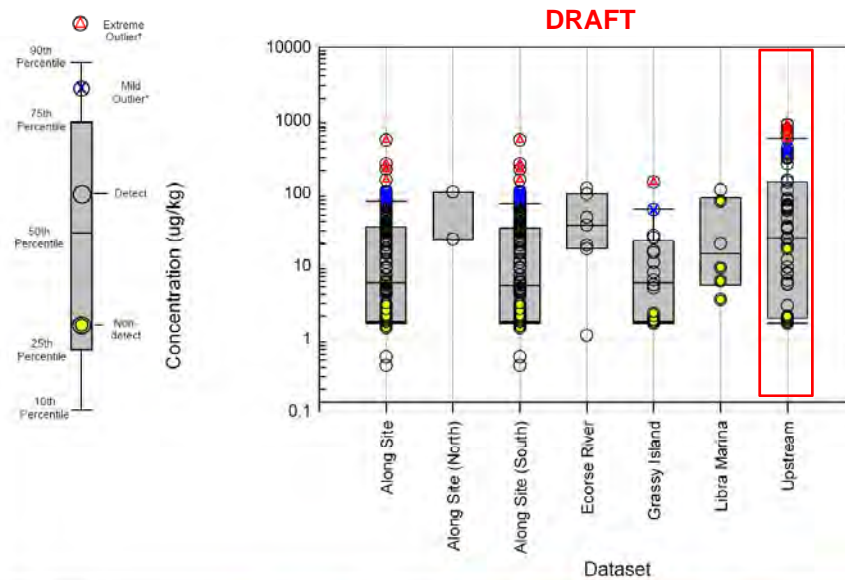
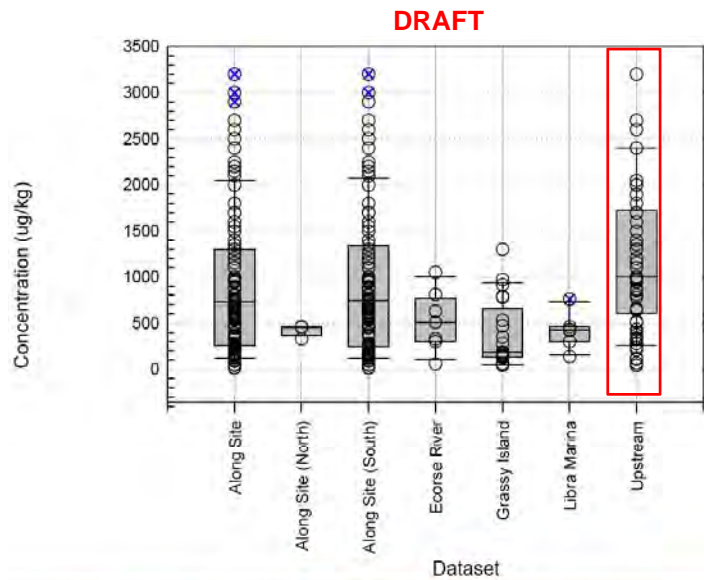
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# Example Boxplots Mercury and 4,4'-DDE



**ARCADIS**  
Infrastructure. Environment. Buildings.

**Sediment Box and Whisker Plot  
MERCURY**  
BASF Corporation, Wyandotte, MI

**Figure  
C-11**

**ARCADIS**  
Infrastructure. Environment. Buildings.

**Sediment Box and Whisker Plot  
4,4'-DDE**  
BASF Corporation, Wyandotte, MI

**Figure  
D-22**

Dataset	Units	Sample Size			ND Range		Detecteds					Percentiles (All Data)			Dataset	Units	Sample Size			ND Range		Detecteds					Percentiles (All Data)		
		NDs	Detecteds	Total	Min	Max	Min	Max	Mean	Median	SD	25th	50th	75th			NDs	Detecteds	Total	Min	Max	Min	Max	Mean	Median	SD	25th	50th	75th
Along Site	ug/kg	0	130	130	NA	NA	14.0	3,200	907	735	742	260	735	1,300	Along Site	ug/kg	43	87	130	1.4	2.9	0.43	530	41.4	23.0	68.5	1.7	5.8	33.0
Along Site (North)	ug/kg	0	3	3	NA	NA	330	460	415	455	73.7	360	455	459	Along Site (North)	ug/kg	0	3	3	NA	NA	23.0	104	49.6	23.0	46.5	23.0	23.0	83.4
Along Site (South)	ug/kg	0	127	127	NA	NA	14.0	3,200	919	740	747	250	740	1,340	Along Site (South)	ug/kg	43	84	127	1.4	2.9	0.43	530	41.1	22.0	69.3	1.7	5.3	32.5
Ecorse River	ug/kg	0	7	7	NA	NA	59.0	1,050	527	510	335	310	510	765	Ecorse River	ug/kg	0	7	7	NA	NA	1.1	115	47.3	36.0	42.9	18.0	36.0	84.3
Grassy Island	ug/kg	0	20	20	NA	NA	44.0	1,300	387	185	370	140	185	655	Grassy Island	ug/kg	8	12	20	1.6	2.2	4.9	140	31.2	15.5	39.2	1.7	5.8	20.0
Libra Marina	ug/kg	0	6	6	NA	NA	140	760	418	425	205	300	425	460	Libra Marina	ug/kg	4	2	6	3.4	77.0	20.0	110	65.0	65.0	63.6	6.1	14.6	77.0
Upstream	ug/kg	0	69	69	NA	NA	41.0	3,200	1,180	1,000	777	610	1,000	1,730	Upstream	ug/kg	20	49	69	1.6	17.0	1.9	870	187	66.0	252	1.9	24.0	140

Notes:

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\* Result value is < 25th percentile - 1.5\*IQR or > 75th percentile + 1.5\*IQR

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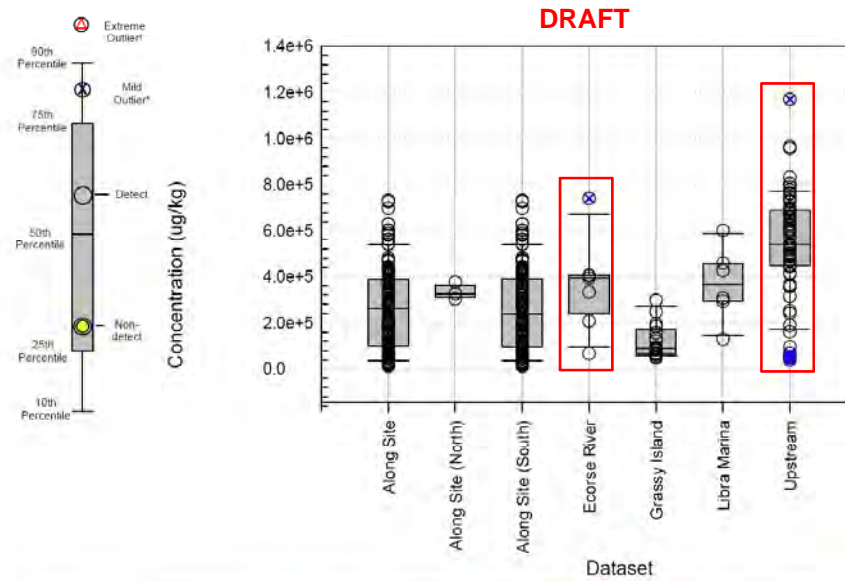
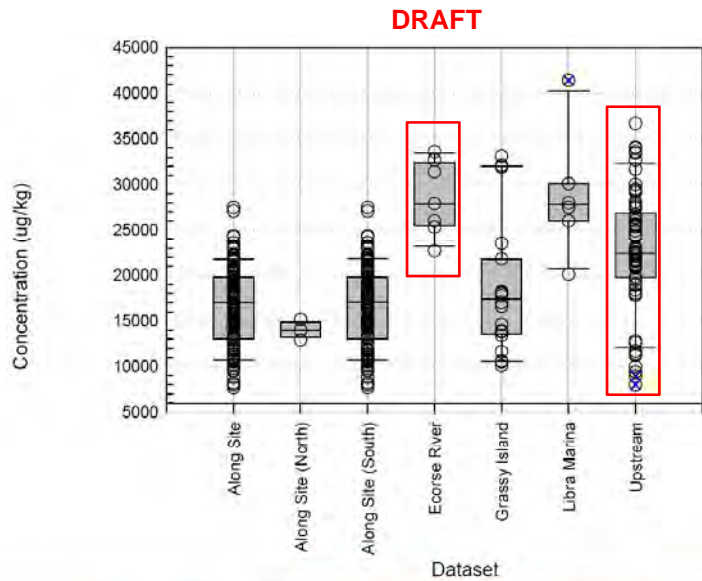
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# Example Boxplots Vanadium and Zinc



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Infrastructure, environment, buildings

**Sediment Box and Whisker Plot  
VANADIUM**

BASF Corporation, Waukegan, MI

**Figure C-16**

Dataset	Units	Sample Size			ND Range		Detects					Percentiles (All Data)		
		NDs	Detects	Total	Min	Max	Min	Max	Mean	Median	SD	25th	50th	75th
Along Site	ug/kg	0	130	130	NA	NA	7,700	27,500	16,500	17,000	4,340	13,000	17,000	19,800
Along Site (North)	ug/kg	0	3	3	NA	NA	12,900	15,150	14,000	14,000	1,130	13,000	14,000	14,900
Along Site (South)	ug/kg	0	127	127	NA	NA	7,700	27,500	16,600	17,100	4,370	13,000	17,100	19,800
Ecorse River	ug/kg	0	7	7	NA	NA	22,700	33,600	28,500	27,900	4,130	25,000	27,900	32,400
Grassy Island	ug/kg	0	20	20	NA	NA	10,100	33,100	18,400	17,400	7,110	14,000	17,400	21,800
Libra Marina	ug/kg	0	6	6	NA	NA	20,100	41,400	28,900	27,800	7,020	26,000	27,800	30,100
Upstream	ug/kg	0	69	69	NA	NA	8,000	36,700	22,800	22,400	6,480	20,000	22,400	26,900

Notes:

† Result value is < 25th percentile - 3\*IOR or > 75th percentile + 3\*IOR

\* Result value is < 25th percentile - 1.5\*IOR or > 75th percentile + 1.5\*IOR

NA = value not applicable due to frequency of detection

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**ARCADIS**  
Infrastructure, environment, buildings

**Sediment Box and Whisker Plot  
ZINC**

DAOF Corporation, Waukegan, MI

**Figure C-17**

Dataset	Units	Sample Size			ND Range		Detects					Percentiles (All Data)		
		NDs	Detects	Total	Min	Max	Min	Max	Mean	Median	SD	25th	50th	75th
Along Site	ug/kg	0	130	130	NA	NA	12,300	732,000	263,000	264,000	183,000	100,000	264,000	389,000
Along Site (North)	ug/kg	0	3	3	NA	NA	304,000	376,000	336,000	327,000	36,800	310,000	327,000	364,000
Along Site (South)	ug/kg	0	127	127	NA	NA	12,300	732,000	262,000	238,000	185,000	98,000	238,000	392,000
Ecorse River	ug/kg	0	7	7	NA	NA	67,500	741,000	365,000	393,000	208,000	240,000	393,000	406,000
Grassy Island	ug/kg	0	20	20	NA	NA	48,900	299,000	126,000	88,900	79,200	69,000	88,900	171,000
Libra Marina	ug/kg	0	6	6	NA	NA	129,000	802,000	369,000	367,000	163,000	290,000	367,000	458,000
Upstream	ug/kg	0	69	69	NA	NA	38,800	1.17E+06	540,000	543,000	230,000	450,000	543,000	690,000

Notes:

† Result value is < 25th percentile - 3\*IOR or > 75th percentile + 3\*IOR

\* Result value is < 25th percentile - 1.5\*IOR or > 75th percentile + 1.5\*IOR

NA = value not applicable due to frequency of detection

ND = nondetect

IOR = interquartile range equals the 3rd quartile (75th percentile) - 1st quartile (25th percentile)

SD = standard deviation

Reporting limit is used for nondetects unless otherwise noted.

Values less than 10 are reported to 2 significant figures. Values greater than 10 are reported to 3 significant figures.

# Preliminary Results of Upstream Vs. Along-Site Statistical Comparisons

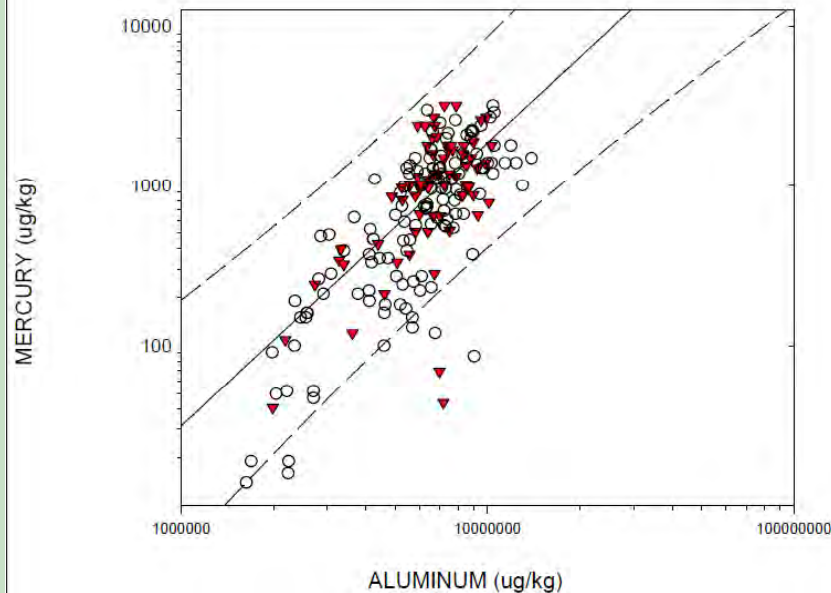
## ■ Inorganics

- Normalized to Aluminum (Al) using bivariate plots for 17 inorganics
  - Preliminary BSLs established based on 95% Prediction Interval (P.I.) for comparison to Along-Site values
- Preliminary BSLs not exceeded for mercury, antimony, barium, cadmium, chromium, cobalt, copper, nickel, silver, vanadium, zinc
  - Consistent with Conceptual Site Model description of continuum of impacts from upstream sources
- Preliminary BSLs exceeded by varying percent of total sample counts for arsenic, beryllium, lead, selenium, and thallium and cyanide
  - Suggests potential localized, incremental impact for some constituents
- Addition evaluation (e.g. hypothesis testing) is currently being concluded

## ■ Organics

- VOCs, SVOCs, PAHs, Total PCBs, 4,4'-DDE
- Evaluation is currently being concluded
- Normalized to TOC

# Example AI Normalization and Prediction Interval Plots



**Sediment Geochemical Regression Plot  
MERCURY**  
BASF Corporation, Wyandotte, Michigan

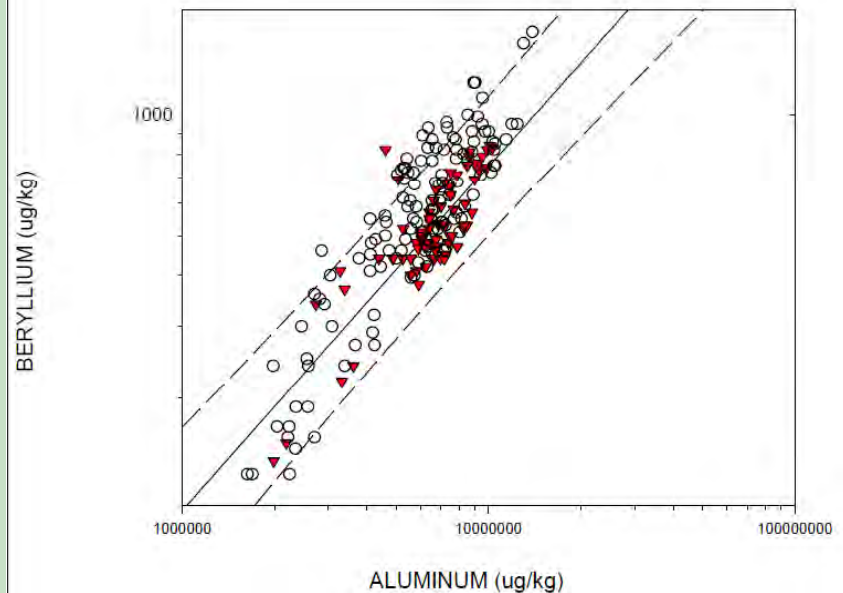
**Figure  
A.12**

Pearson's Correlation Coefficient = 0.630

Dataset	Units	Pairs	MERCURY		ALUMINUM		
			Min	Max	Min	Max	
Along Site	ug/kg	130	14.0	3,200	1,630,000	13,900,000	○ Along Site Area ▼ Upstream Reference Area — Concentration Ratio Regression - - 95% Prediction Interval
Upstream	ug/kg	69	41.0	3,200	1,990,000	10,300,000	

**Notes:**

Linear regression and 95% prediction interval based on the upstream population



**Sediment Geochemical Regression Plot  
BERYLLIUM**  
BASF Corporation, Wyandotte, Michigan

**Figure  
A.5**

Pearson's Correlation Coefficient = 0.830

Dataset	Units	Pairs	BERYLLIUM		ALUMINUM		
			Min	Max	Min	Max	
Along Site	ug/kg	130	130	1,600	1,630,000	13,900,000	○ Along Site Area ▼ Upstream Reference Area — Concentration Ratio Regression - - 95% Prediction Interval
Upstream	ug/kg	69	140	840	1,990,000	10,300,000	

**Notes:**

Linear regression and 95% prediction interval based on the upstream population

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# NEXT STEPS & SCHEDULE



## Next Steps

- Complete Draft Phase II Sediment Investigation Report for Agency Review
- Develop plan outline to address data needs, determine exposure conditions in Study Area
- Provide plan outline to USEPA, MDEQ
  - Conference call with Agencies to discuss approaches
  - Submit Draft Work Plan for Agency review
- Explore and evaluate options for addressing sediment concerns
- Collect supplemental data needed to close data gaps
- Meet with USEPA and MDEQ to review additional data, considerations on options, and path forward

# Supplemental Data Collection

- Core sampling for field measurement of pH and visual observation
  - Delineate elevated pH around Libra Marina ■
  - Delineate elevated pH in Along-Site Area ■
  - Determine depth to top of clay
  - Collect step-out cores beyond 100 ft for additional analysis
- Near-bottom surface water pH measurements
- Sediment-water interface pH measurements
  - Assess bioavailable zone conditions
- Evaluate Surface Sediment Geochemistry
- Sediment Profile Imaging (SPI) survey ■
- Multi-beam sonar bathymetric survey ■



Example SPI photograph of benthic zone after disposal of drilling mud (light sand material over dark drilling mud)

# Estimated Schedule

## North Works Sediments Investigation and Reporting Activities

	2009-Q1			2009-Q2			2009-Q3			2009-Q4		
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
USEPA Approval of Phase II Work Plan	complete											
Phase II Investigation Field Work	complete											
USEPA/MDEQ Preliminary Data Package	submitted December 2008											
Laboratory Analysis and Data Validation	complete											
USEPA/MDEQ Meeting to Present Draft Results				◆ Today								
Draft Data Summary Report				◆ 3/31								
Data Gap Work Plan Outline					◆ 4/29							
Call to discuss Work Plan Outline						◆ 5/8						
Data Work Plan for USEPA/MDEQ Review						◆ 5/19						
Approved Work Plan						◆ 5/27						
Field Activities, Lab Analysis, Data Validation and Reporting							◆	◆	◆	◆	◆	
Meeting to Discuss Data and Options, Path Forward												◆
Complete SLERA	TBD											

### key

- ◆ = update call/meeting with USEPA
- ◆ = Submittal for USEPA review
- ◆ = USEPA document approval